



PRESIDENT'S MALARIA INITIATIVE



# Basic Entomology Technicians Training Report—Liberia

Integrated Vector Management (IVM) Task Order 2

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Prepared by:

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# **Consultants Report on Applied Entomology Technician's Training Course**

**26<sup>th</sup> January – 12<sup>th</sup> February 2010**

**Liberia, Monrovia**

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# **Applied Entomology Technician's Training Course**

**26<sup>th</sup> January – 12<sup>th</sup> February 2010**

**Participants and facilitators at the Applied Entomology Technician training course**

**Monrovia, Liberia**

## **Introduction**

The workshop on applied entomology was held in Liberia from the 26<sup>th</sup> January to 11<sup>th</sup> February 2010. The course was organized and funded by RTI in collaboration with the Malaria control Programme in Liberia and the Liberia Institute for Medical Research.

The facilitators for the course were Dr. Maxwell Appawu and Dr. Samuel Dadzie ( Noguchi Memorial Institute for Medical Research, Ghana), with support from Kathryn Welter (RTI International, Washington, USA) and Mr Martin Netsa (Chief of Party, RTI Liberia).

There were in total 44 participants selected across all the counties in Liberia. Most of the participants were Environmental Health Officers (EHOs) and from the National Malaria Control programme in Liberia (Annex 5).

The Applied Entomology technician course had the overall goal of strengthening the national vector control under the national malaria control program that will result in more effective and more efficient actions to reduce malaria transmission. The course covered basic principles of malaria control and practical skills in basic entomology.

Specifically, the course had the following objectives:

At the end of the course each participant was to be able to:

- Conduct malaria vector sampling and identification
- Identify and perform various techniques of vector control
- Conduct and supervise insecticide susceptibility test and cone wall bioassays
- Understand the principles and rationale of some interventions such as IRS

The course structure and modules covered vector biology, entomological techniques, principles and practice of vector control. The course was participatory and interactive and to ensure relevance of course, each participants took a pre- and post course examination. There was also extensive field work and practical demonstrations.

## **Course programme**

### **Week 1**

The course commenced on Tuesday, January 26, 2010 at Zeo Hotel, Liberia. In attendance were 35 participants. The course began with the introduction of training staff and the participants. The participants were then asked by Mr Martin Netsa to list their fears and hopes for the course. Dr Samuel Dadzie and Maxwell Appawu introduced the participants to the training materials. Thereafter, the participants took a pre-assessment quiz to assess their level of understanding in basic entomology. Mr Martin Netsa (Chief of Party in Liberia) interacted with the participants and discussed the hopes and fears of the course. Most participants hoped that at the end of the course, they will acquire knowledge, practical experience and understand issues of vector control. There were others that complained about the venue for the course and had some issues about logistics. Drs Appawu and Dadzie discussed the pre-assessment quiz and course objectives with the participants and thereafter, Dr Dadzie gave an introductory lecture on the lifecycle of malaria vectors and the significance of each aspect of the cycle in malaria control. The rest of the afternoon was used by Mr Martin Netsa to discuss the logistical issues raised during the morning section.

The next day, the venue for the course was moved to the Thinkers Village where the official opening of the course was performed. Those present at the official opening were Mr. Joseph Tamba (Deputy Malaria control program manager in Liberia), Dr. Filiberto (CDC/PMI), Mr. Payne Nyansaiye and Mr. Tolbert Nyenswah (National malaria control programme). Mr Tamba emphasized the importance of the course in the fight against malaria in Liberia and asked the participants to take the course serious. The total number of participants present was 42.

After the opening ceremony, the participants were taken through lectures (Annex 1). Topics included:

- 1) The Biology of Malaria Vectors (Dr. Appawu)
- 2) Mosquito Anatomy and Identification (Dr. Dadzie)
- 3) Mosquito survey (Larvae)-- Methods for sampling larvae (Dr. Dadzie)

- 4) Role of IRS in Malaria Vector Control (Mr. Martin)
- 5) Adult Mosquito Survey (Dr. Appawu).
- 6) The participants were shown a video on Field Entomological Techniques: “Malaria Entomology: Part I” (Drs Appawu and Dadzie).
- 7) Mosquito lifecycle (Dr Appawu)
- 8) Determination of transmission parameters and mosquito collection methods,
- 9) Estimation of malaria transmission parameters (Dr. Dadzie),
- 10) Resistance of mosquitoes to insecticides (Dr. Dadzie),
- 11) WHO tests available for determining resistance (Drs. Appawu and Dadzie)
- 12) Mosquitoes identification (Dr. Dadzie),
- 13) Breeding and maintenance of mosquitoes colonies (Dr. Dadzie),
- 14) Insectary Management—Standard Operating Procedures (Dr. Appawu)
- 15) Field site and community interaction (Dr. Appawu)
- 16) Malaria Vector Control (Drs Appawu and Dadzie).
- 17) The participants were also taken through a video on Field Entomological Techniques: “Malaria Entomology: Part II” (Drs Appawu and Dadzie).

## **Week 2**

On the Monday, February 1, 2010, the participants were moved to Liberia Institute for Medical Research (LIBR) about half an hour drive from Monrovia. There were modifications on the original programme because of some logistical issues. The morning of the Monday was used by Martin Netsa to discuss some issues with the participants.

The rest of the week was devoted to field and practical demonstrations. The participants were divided into two groups. Each group took turns to do fieldwork which included:

### **1) Pyrethrum spray catches**

*The participants practiced how to do community entry, laying of spray sheets, spraying rooms with insecticide and collection of mosquitoes into petri dishes (Figure 1).*

*They were then taught how to use some morphological features to sort out the mosquitoes into different species, classify the mosquitoes into the different abdominal stages and calculate room density etc.*

**2) Human landing catches**

*Participants were divided into groups. 2 participants (1 indoors and 1 outdoors) and practiced how to collect mosquitoes off their legs with an aspirator or test tube and transferring the mosquitoes into a paper cup (Figure 2). They were then taught how to use some morphological features of the mosquitoes to sort out the mosquitoes into different species and calculate man-biting rates, sporozoite rates and entomological inoculation rates (EIRs) etc.*

**3) Larval sampling and transportation**

*Participants were taken to the field to survey for mosquito larvae. This involved the identification of preferred breeding sites for Anopheles, using different larval collection methods to sample larvae (Figure 3) and transporting the larvae to the laboratory for sorting (Figure 3 &4).*

**4) Practical demonstration of the techniques to detect insecticide resistance in mosquitoes**

*The facilitators did a practical demonstration of the insecticide susceptibility test and cone wall bioassays with the participants and how to interpret the data from the assays. The demonstration was interactive and participatory.*

The participants were also taken through a video on Field Entomological Techniques: “Malaria Entomology: Part III.

### **Week 3**

The third week was devoted to a review of previous lectures, practicals, discussions and assessments. There was also an introductory lecture on Integrated Vector management (IVM) by Drs Maxwell Appawu and Samuel Dadzie (NMIMR, Ghana). The lecture focused on the definitions, elements and strategy of IVM.

Mr Martin Netsa (COP, RTI, Liberia) gave a lecture on “Malaria Surveillance: Putting Things into Perspective”. This covers the plan for vector surveillance and how the participants were going to use techniques learned in the training for the benefit of the malaria control programme and the people of Liberia.

The participants were also given a recap on the various entomological techniques especially the aspect on sorting and mosquito identification and entomological monitoring of IRS before and after spraying using techniques studied.

The closing ceremony of the course was performed by Mrs. Jessie E. Duncan, Deputy Chief Medical Officer (CMO)/ Assistant Minister Preventive Services and in attendance were the Director of LIBR, Mr Martin Netsa (COP, RTI, Liberia), Mr. Joseph Tamba (Deputy Malaria control program manager in Liberia) and Dr. Filiberto (CDC/PMI).

Certificates were awarded to each of the 44 participants for participating in the three week course after the post-assessment quiz.

### **Development of surveillance and entomological monitoring plan for Liberia**

The facilitators developed surveillance and entomological monitoring plan which will be adopted by the National Malaria control programme and RTI as part of vector surveillance activities and monitoring of indoor residual spraying in Liberia. The plan involved 1) collection of mosquitoes, 2) package and labelling of mosquito samples with a dessicant with information on place, date, and type of collection, 3) sorting and identification of mosquitoes 4) how to calculate the malaria transmission indices such as man biting rates, EIRs etc and 5) how to conduct baseline survey (before IRS) and monitoring of adult densities. The facilitators also made a list of the items that each vector surveillance officer will need for the various activities in their counties.



The plan was discussed with all the participants and made available to Gracellar Cooper (vector surveillance officer, NMCP) as well as Mr Martin Netsa (chief of party, RTI, Liberia).

### **Insectary setup and management**

The facilitators helped to plan the setting up of the insectary at LIBR. The demarcations for the larvae and adult rooms were done as well as the shelves for the cages. With the advice of the facilitators, six participants were selected and trained to manage the insectary. The selected participants were taken to the field to collect larvae. The larvae were transported to the insectary and the participants were taken through the various aspects of insectary practices, management and how to use the equipments in the insectary. The participants were each provided with standard operating procedures (SOPs) for the insectary. The facilitators also helped to sort out the various equipments that will be used in the insectary.

### **Assessment of participants**

During the pre-assessment of participants, 20 out of the 44 participants achieved a score of above 50%. However, the post-assessment indicated that all 44 participants achieved a score of 75% or higher.

### **Evaluation of the course**

In evaluating the training course, 67% of the participants rated the course as excellent, 64% rated the contents of the course as excellent and 71% rated the delivery of the lectures as excellent. Also, 36% rated the demonstrations and laboratory practicals as excellent and 31% as above average. 60% of the participants rated field activities as excellent. 43% and 45% rated the food service and accommodation as average and below average respectively (Table 1).

There were some comments from the participants regarding various aspects of the course. Some of the comments were:

Participant 1

*“The training section was very rewarding for me because from the lectures of the facilitators. I am able to differentiate between anopheles, culex and aedes mosquitoes. The financial matter was not encouraging from Bro. Martin. I suggest that this program be fully supported to enable us to train others as we were trained.”*

Participant 2

*“I suggest that all those that take part in this training should be given a job with RTI International. I also suggest that we are able to do whatsoever they have taught us during the period.”*

Participant 3

*“I suggest that the program gave good incentive for motivation which will enable the field worker to do their work in the county. That the program provide incentive for all vector officers in various counties know that training without implementation is a waste. The incidental given us was very small to keep us up.”*

Participant 4

*“First of all, I thank you the facilitators for adequately delivering the entire course in an excellent manner. I recommend that the training we have received should be spread to others. I further recommend that RTI should strategize for us to be effective in terms of implementation. Conclusively, I must commend you for your job well done. May God Almighty bless you in all your endeavors. I pray to come one day at your research center.”*

Participant 5

*“ These lecturers should come back again at least twice a year. More people sent to Ghana for study in entomology or other related courses. Malaria control should allow us to be part of their training in the various counties. Only environmentalists should be working in the entomology section of malaria control .”*

## **Conclusions and recommendations**

In general, based on the assessments, the applied entomology course was successful. There were some major logistical problems with regards to the venue of the course and transport allowances for participants. The venue had to be changed three times and issues of accommodation for the participants posed a major challenge to the programme. We had to make some changes to the programme in the first week based on the pre-assessment and some logistical issues. Although we made all the effort to get the insectary fully functional, we did not receive the full cooperation from RTI in Liberia. Therefore as at the time the course ended, some infrastructure was still not in place.

We recommend:

- that future workshops or training should select participants who have basic qualification (at least Senior High School level), so as to enable them better understand the basic principles and theory behind most of the techniques.
- that all the participants should be given the necessary support to enable them start vector surveillance activities in their respective counties. This will help provide information on the different vector species that occur in the various areas of the country which is currently not available.
- further training in Enzyme Linked Immunosorbent Assays (ELISA) and Polymerase Chain Reactions (PCR) for some selected participants who took part in this course. This will complement the vector surveillance activities including vector incrimination techniques and molecular identification of vector species. This aspect of vector surveillance was not included in the programme.
- that follow-up visits to Liberia should be arranged to assist and monitor the implementation of the vector surveillance activities

**Annex 1**  
**APPLIED ENTOMOLOGY TRAINING COURSE**  
**Venue: Liberia Institute for Biomedical Research**  
**Monrovia, Liberia,**  
**26<sup>th</sup> January-12 February 2010**

**Programme**

**Tuesday, 26th January 2010**

<b>Biology and diversity of malaria vectors</b>		
09:00-09:15	<b>1. Welcome</b>	
09:15-09:45	<b>2. Pre-assessment of participants</b>	All facilitators
09:45-10:30	<b>3. Discussion of pre-assessment</b>	All facilitators
10:30-11:00	<b>4. Course objectives</b>	
11:00-11:45	<b>4. History of malaria vector control in Liberia</b>	
11:45-12:30	<b>5 Biology of malaria vectors</b> <ul style="list-style-type: none"> <li>• Life-cycle and significance of each aspect of the cycle in malaria control</li> <li>• Larval habitats and conditions affecting adult production</li> </ul>	
12.30-13.30	Lunch	
13.30-14:30	<b>6. General discussion</b>	
17:30-18:45	<b>7. Close</b>	

Wednesday 27<sup>th</sup> January 2010

Mosquito biology, survey and species identification		
09:00-09:45	<b>8. Biology and diversity of malaria vectors</b> <ul style="list-style-type: none"> <li>Different species of malaria vectors and implications for control</li> </ul>	Dr M. A. Appawu
09:45-10:30	<b>9. Vector behaviour and its significance in malaria control</b>	Dr M. A. Appawu
10:30-11:00	Coffee break	
11:00-12:30	<b>10. Mosquito survey (larvae)</b> <ul style="list-style-type: none"> <li>Range of larval habitats</li> <li>Sampling and preservation of samples</li> <li>Environmental factors recorded</li> <li>Data analysis</li> </ul>	Dr S K. Dadzie
12:30-13:30	Lunch	
13:30-14:00	<b>11. Mosquito survey (Adults)</b> <ul style="list-style-type: none"> <li>Types of mosquito surveys</li> <li>Mosquito sampling techniques (HBC, CDC, PSC) etc <ul style="list-style-type: none"> <li>Limitations of each technique</li> </ul> </li> </ul>	Dr. S. K. Dadzie
14:00-16:00	<b>12. Vector incrimination</b> <ul style="list-style-type: none"> <li>Factors that determines a mosquito as a vector</li> </ul>	Dr M. A. Appawu
16:00-16:30	Coffee break	
16:30-18:00	<b>13. Mosquito identification</b> <ul style="list-style-type: none"> <li>Mosquito anatomy</li> </ul>	Dr S. K. Dadzie

	<ul style="list-style-type: none"> <li>• Features used for identification</li> </ul>	
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**Thursday, 28th January 2010**

<b>Malaria transmission parameters, insecticide susceptibility and Bioassay test</b>		
09:00-10:30	<b>14. Factors affecting malaria transmission</b>	Dr S K Dadzie
10:30-11:00	Coffee break	
11:00-11:45	<b>15. Estimation of malaria transmission parameters</b> <ul style="list-style-type: none"> <li>• Man biting rates</li> <li>• Sporozoite rates</li> </ul> Human Blood index, EIR <b>16. Handling and procession of mosquitoes</b> <ul style="list-style-type: none"> <li>• Mosquito dissection for sporozoites</li> <li>• Estimating parity of mosquitoes</li> </ul>	Dr S. K. Dadzie
11:45-12:30	<b>17. . Insecticide resistance in mosquitoes</b>	Dr. M.A. Appawu
12:30-13:30	Lunch	
13:00-14:45	<b>18. Type of tests available from WHO for monitoring IRS</b> <b>19. Rationale for determining insecticide susceptibility and cone bioassays</b>	Dr M. A. Appawu
14:45-15:30	<b>20. Instructions on insecticide susceptibility and cone bioassay</b>	Dr. S. K. Dadzie
15:30-16:00	Coffee break	
16:00-17:00	<b>21 Practical demonstration of WHO bioassay and Cone Test</b> <b>22. Malaria entomology Video</b>	Dr. S K. Dadzie

**Friday 29<sup>th</sup> January 2010**

Insectary management and basic entomological laboratory techniques		
09:00-09:45	<b>23 RECAP OF OF PREVIOUS DAYS LECTURES</b>	Dr. M. A. Appawu
09:45-11:00	<b>24 Establishment and maintenance of mosquito colony</b>	Dr. M. A. Appawu Dr S. K. Dadzie
11.00-11.30	<i>Coffee break</i>	
11.30-12.30	<b>25 Standard operating procedures (SOP’s) for colony maintenance</b>	Dr. M. A. Appawu Dr. S.K. Dadzie
12:30-14.00	<i>Lunch</i>	
14:00-15:00	<b>26 Training of mosquito collectors and supervision</b> <ul style="list-style-type: none"><li>Recruitment of field workers (who, how many for the tasks etc)</li></ul>	Dr. M. A. Appawu Dr S.K. Dadzie
15:00-15:30	<i>Coffee</i>	
15:30 -17.00	<b>27 Meet with COP to review the first weeks programme and sort out the equipment for practicals and the insectary</b>	

**Saturday 30<sup>th</sup> January 2010**

<b>Insectary setup and arrangement of practicals</b>		
09:00-10:00	<b>28. Leave for LIBR</b>	
10:00-13:00	<b>29. Insectary setup</b>	
14:00-16:30	<b>30. Arrange for practicals next week</b>	

**Sunday, 31<sup>st</sup> January 2010**

<b>OFF</b>
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**Monday, 1<sup>st</sup> February 2010**

<b>Malaria control</b>		
07:00-09:00	<b>31. Mosquito collection –Pyrethrum Spray Sheet</b> <b>Collection of indoor resting mosquitoes</b>	All facilitators
11:30-12:00	<b>32. Principles and techniques of malaria vector control</b> Dr S K. Dadzie	
11:00-12:00	<b>33. Indoor residual spraying</b>	Dr M. A. Appawu
12:00-13:00	<b>34. Introduction to Malaria integrated vector management</b>	Dr S. K. Dadzie
13:00-14:00	<i>Lunch</i>	
14:00-16:00	<b>35. Practice sorting and identification of field collected mosquitoes</b>	All facilitators
16:00-18:30	<b>36. PRACTICE HUMAN LANDING CATCHES (HLC) (GROUP 1)</b>	

**Tuesday, 2<sup>nd</sup> February 2010**

<b>Practicals ( PSC )-GROUP 1</b>		
9.00 – 11:30	<b>37. Pyrethrum Spray Sheet Collection of indoor resting mosquitoes</b>	
10.00-12.30	<b>38.Processing of samples from HLC &amp; PSC</b>  Mosquito sorting and identification Data handling and analysis	Dr. S.K Dadzie
12:30-13:30	Lunch	
13:30-14.45	<b>39.Calculation of malaria transmission parameters</b> <ul style="list-style-type: none"> <li>• Man biting rates</li> <li>• Sporozoite rates</li> <li>• EIR</li> <li>• Room density</li> </ul>	Dr. S.K Dadzie Dr. M.A. Appawu
14:45-14:15	Coffee	
15:00-18:30	<b>40 PRACTICE HUMAN LANDING CATCHES (HLC) (GROUP 2)</b>	Dr. S.K Dadzie Dr. M.A. Appawu

**Wednesday, 3<sup>rd</sup> February 2010**

Practicals (NBC & PSC )-GROUP 2		
9:00-11.30	<b>41 Pyrethrum Spray Sheet Collection of indoor resting mosquitoes</b>  <b>42.Processing of samples from HLC &amp; PSC</b>  Mosquito sorting and identification Data handling and analysis	Dr. S.K Dadzie
11.30-12.30		
12:30-13:30	Lunch	
13:30-14.45	<b>43.Calculation of malaria transmission parameters</b> <ul style="list-style-type: none"><li>• Man biting rates</li><li>• Sporozoite rates</li><li>• EIR</li><li>• Room density</li></ul>	Dr. S.K Dadzie Dr. M.A. Appawu
14:45-14:15	Coffee	
14:15-16:00	<b>44. Calculation of malaria transmission parameters</b> <ul style="list-style-type: none"><li>• Man biting rates</li><li>• Sporozoite rates</li><li>• EIR</li></ul>	Dr. S.K Dadzie Dr. M.A. Appawu

Thursday, 4<sup>th</sup> February 2010

Practicals (NBC & PSC )-GROUP 1&2		
9:00-11.30	<b>41 Pyrethrum Spray Sheet Collection of indoor resting mosquitoes</b>  <b>42.Processing of samples from HLC &amp; PSC</b>  Mosquito sorting and identification Data handling and analysis	Dr. S.K Dadzie
11.30-12.30		
12:30-13:30	Lunch	
13:30-14.45	<b>43.Calculation of malaria transmission parameters</b> <ul style="list-style-type: none"><li>• Man biting rates</li><li>• Sporozoite rates</li><li>• EIR</li><li>• Room density</li></ul>	Dr. S.K Dadzie Dr. M.A. Appawu
14:45-14:15	Coffee	
14:15-16:00	<b>44. Calculation of malaria transmission parameters</b> <ul style="list-style-type: none"><li>• Man biting rates</li><li>• Sporozoite rates</li><li>• EIR</li></ul>	Dr. S.K Dadzie Dr. M.A. Appawu

**Friday, 5th February 2010**

<b>Practicals (LARVAL SURVEY)-GROUP 1&amp;2 (In groups)</b>		
9.00-13.30	<b>45.Larval survey and identification</b> Larval identification Preservation	Dr. S.K Dadzie Dr. M.A. Appawu
13:30-14:30	Lunch	
14:30-16:30	<b>46 Data handling</b>	Dr. S.K Dadzie Dr. M.A. Appawu
16:30-17:00	Coffee	
17:30 -18.30	<b>47 General discussion</b>	Dr. S.K Dadzie

**Saturday, 6<sup>th</sup> February 2010**

<b>INSECTARY SET UP</b>		
10.00-15.30	<b>48. Insectary &amp; Mosquito colony management</b>	Dr. S.K Dadzie Dr. M.A. Appawu

**Sunday, 7<sup>th</sup> February 2010**

<b>OFF</b>
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**Monday 8<sup>th</sup> February 2010**

<b>Practicals on Insecticide susceptibility testing and Cone Assay</b>		
09:00-09.45	<b>49 RECAP of insecticide susceptibility lecture</b>	Dr. S.K Dadzie Dr. M.A. Appawu
09:45-11:30	<b>50 Insecticide susceptibility testing</b>	Dr. S.K Dadzie Dr. M.A. Appawu
11:30-12:00	<b>51 Data analysis</b>	
12:30-13:45	<i>Lunch</i>	
14:45-15:30	<b>52 Techniques for Cone Assay</b>	Dr. S.K Dadzie Dr. M.A. Appawu
15:30-16:00	<b>53 Data analysis</b>	
16:30-15:00	<i>Coffee</i>	
15:00-16:30	<b>54 General Discussion</b>	

**Tuesday, 9th February 2010**

<b>Set up mosquito colonies in the Insectary</b>		
09:00-13:45	<b>55 Larval survey</b>	Dr. S.K Dadzie
13:45-14:30	<i>Lunch</i>	
14:30-17:30	<b>56 Processing of larvae for breeding in the insectary</b>	

**Wednesday, 10th February 2010**

<b>Develop vector surveillance (VS) plan for Liberia</b>		
09:00-13:30	<b>57. Develop VS plan for monitoring IRS</b>	Dr. S.K Dadzie Dr. M.A. Appawu
13:30-14:30	<i>Lunch</i>	
15:00-17:30	<b>58 Meet with COP to discuss VS plan</b>	
18:00 -22:00	<b>59. PRACTICE HUMAN LANDING CATCHES- ALL GROUPS</b>	

**Thursday, 11th February 2010**

<b>Discussions on theory and practicals</b>		
09:00-12:30	<b>60 Discussion of theory and practicals</b>	All facilitators
12:30-13:00	<i>Coffee break</i>	
13:00-14:00	<b>61 Post-assessment</b>	All facilitators
14:00-15:30	<i>Lunch</i>	
15:30-16:30	<b>62 Discuss post-assessment</b>	All facilitators
16:30-17:30	<b>64 Closing ceremony &amp; Award of Certificates</b>	

Friday, 12<sup>th</sup> February 2010

Other issues		
09:00-13:30	<b>64 Meet with COP and other stakeholders</b>	
13:30-14:30	<i>Lunch</i>	
15:00-17:30	<b>65 Meet with COP to discuss other any issues of interest</b>	



**Annex 2**  
**Pre-course assessment**  
**(Applied Entomology)**

Name:

Occupation:

County / District:

Qualification:

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1. Can you identify the *Anopheles* mosquito?
  - a. Yes
  - b. No
  
2. All mosquitoes suck our blood
  - a. True
  - b. False
  
3. All mosquitoes bite human
  - a. True
  - b. False
  
4. The malaria mosquito prefer to breed in dirty, polluted water covered with vegetation.
  - a. True
  - b. False

5. The *Anopheles* mosquito transmits yellow fever and malaria

- a. True
- b. False

6. The *Anopheles*, *Culex* and *Aedes* mosquitoes transmit malaria

- a. True
- b. False

7. It is only the female *Anopheles* mosquito that bites and sucks blood

- a. True
- b. False

8. *Anopheles* mosquito go through the following stage of development

- a. Egg, naiad, pupa, adult
- b. Egg, larva, pupa, adult
- c. Egg, larva, nymph, adult
- d. Egg, nymph, adult

9. There are different types of the malaria mosquito

- a. True
- b. False

10. The malaria mosquito has mouthparts useful for sucking
- a. True
  - b. False
11. Anopheles vector species distribution is affected by
- a. Rainfall
  - b. Humidity
  - c. Temperature
  - d. Soil temperature
  - e. Wind direction
12. Malaria vector control is an important component of the global strategy of control
- a. True
  - b. False
13. The malaria mosquito peak biting time is between
- a. 6pm-9pm
  - b. 6am-12noon
  - c. 9pm-12am
  - d. 1am-3am
14. Insecticide Treated Nets can be used to prevent mosquito bites
- a. True
  - b. False

15. Insecticide Treated Nets reduces malaria deaths

- a. True
- b. False

16. Female malaria mosquitoes lay single eggs whilst some other lay eggs in raft

- a. True
- b. False

17. Do you know that some mosquitoes are resistant to insecticides?

- a. Yes
- b. No

18. Indoor residual spraying is used as part of the Ghana National Malaria Control Programme

- a. True
- b. False

19. Only female *Anopheles* mosquitoes take blood meal

- a. True
- b. False

**Annex 3**  
**Post-course assessment**  
**(Applied Entomology)**

Name:

Occupation:

County:

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1. Tick 2 morphological characters used for identifying adult Anopheles mosquitoes from *Culex* and *Aedes*?
  - a. pattern on the wings
  - b. length of palp and proboscis
  - c. foreleg
  - d. size of the eye
  
2. The palp of *Culex* and *Aedes* mosquitoes is as long as the proboscis
  - a. True
  - b. False

3. Tick 2 breeding sites preferred by the *Anopheles* mosquito

- a. rice fields
- b. concrete drains
- c. rubbish dump
- d. flowing streams
- e. tree holes
- f. temporary pools (puddles)

4. All *Anopheles* mosquitoes feed indoors at night

- a. True
- b. False

5. All *Anopheles* mosquitoes rest outdoors after feeding

- a. True
- b. False

6. Female *Anopheles* mosquitoes will need to take at least two blood meals from human beings to be able to transmit malaria parasite.

- a. True
- b. False

7. Tick 3 methods used for collecting adult mosquitoes
- a) light trap,
  - b) dipping
  - c) human landing catches
  - d) pipetting
  - e) pyrethrum spray collection
8. Indoor Residual Spraying is to kill indoor resting mosquitoes
- a. True
  - b. False
9. There is the need to determine the insecticide resistance/susceptibility status of *Anopheles* mosquitoes before IRS
- a. True
  - b. False
10. What factors make *Anopheles* mosquito a good vector?
- a. It must be biting human
  - b. It must be able to develop the parasite in the body
  - c. It must live long enough to allow the parasite to go through full development
  - b. It must be able to fight the malaria parasite
11. Pyrethrum Spray Catches is normally used to estimate room density of mosquitoes
- a. True
  - b. False
12. *Culex* and *Aedes* larvae have a siphon whilst *Anopheles* mosquitoes do not
- a. True
  - b. False

13. An abdominal stage of an adult mosquito can either be
1. Unfed
  2. Blood fed
  3. Half-gravid
  4. Gravid
- a. True
- b. False
14. Tick 3 methods used for sampling the larval stages of mosquitoes
- a. Dipping
  - b. Netting
  - c. Sucking
  - d. Aspiration
  - c. Pipetting
15. Larval surveys need to be carried out immediately after the rains
- a. True
  - b. False
16. Human landing catches can be done both indoors and outdoors
- a. True
  - b. False



17. Pyrethrum Spray Catches is normally done early in the morning from about 6am-9am.
- a. True
  - b. False
18. In transporting mosquito larvae, one needs to avoid undue shaking of the container
- a. True
  - b. False
19. The Entomological inoculation rate (EIR) is man biting rate x sporozoite rate
- a. True
  - b. False
20. Cone wall bio-assay will help to determine how well the spraying was done in IRS operations.
- a. True
  - b. False
21. During WHO insecticide susceptibility testing, 98-100% mortality indicates resistance
- a. True
  - b. False
22. Cone Wall Bioassay is used to test the efficacy of insecticides on different wall surfaces
- a. True
  - b. False

23. During Pyrethrum Spray Collection (PSC) in Maryland county, *Anopheles* mosquitoes collected from 4 rooms were 22, 18, 11 and 13. What is the room density for *Anopheles* in the area?
- a. 18 *Anopheles* per room
  - b. 16 *Anopheles* per room
  - c. 8 *Anopheles* per room
  - d. 20 *Anopheles* per room
24. During 4 nights of human landing catches (HLC), 2 people collected a total of 40 *Anopheles* mosquitoes in Grand Krue county. What is the man biting rate of *Anopheles* in the area?
- a. 7 bites per man per night
  - b. 8 bites per man per night
  - c. 5 bites per man per night
  - d. 40 bites per man per night
25. The EIR indicates the risk of being bitten by a mosquito that has sporozoites in its salivary glands
- a. True
  - b. False
26. The hind legs of *Anopheles funestus* is normally dark with no white markings
- a. True
  - b. False

27. The wings of *Anopheles* mosquitoes has a white and dark markings whilst that of *Culex* and *Aedes* do not have any dark markings
- a. True
  - b. False
28. The antenna of male adult mosquitoes has lots of hairs compared to that of the female
- a. True
  - b. False
29. Tick 4 methods that can be used to control mosquitoes
- a. Indoor residual spraying (IRS)
  - b. Insecticide Treated Nets
  - c. Burning of bushes
  - d. Larviciding
  - e. Clearing of refuse
  - f. Repellents
30. In the insectary, pupa of mosquitoes should be removed and placed in cages every morning and evening.
- a. True
  - b. False
31. The abdomen of mosquitoes collected from human landing catches are mostly
- a. Blood fed
  - b. Unfed (empty)
  - c. Gravid
  - d. Half gravid

## Annex 4

### Course assessment

#### APPLIED ENTOMOLOGY COURSE APPRAISAL

26TH JANUARY- 12TH FEBRUARY, MONROVIA, LIBERIA

Please rate the training course as: ☐ 1 = Excellent  
☐ 2 = Above average  
☐ 3 = Average  
☐ 4 = Below average  
☐ 5 = Poor

---

1. How do you rate the contents of the course?

☐ = Excellent  
☐ = Above average  
☐ = Average  
☐ = Below average  
☐ = Poor

2. How do you rate the delivery of the lectures?

☐ = Excellent  
☐ = Above average  
☐ = Average  
☐ = Below average  
☐ = Poor

3. How do you rate the demonstrations and laboratory practicals

☐ = Excellent  
☐ = Above average  
☐ = Average  
☐ = Below average  
☐ = Poor

4. How do you rate the field activities?

□ = Excellent

☐ = Above average

$\square$  = Average

☐ = Below average

☐ = Poor

## Organization of the Training

5. How do you rate the food service?

☐ = Excellent

☐ = Above average

□ = Average

☐ = Below average

$\square =$  Poor

6. How do you rate the accommodation?

☐ = Excellent

☐ = Above average

□ = Average

☐ = Below average

☐ = Poor

Other comments or suggestions:

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**Table 1** Responses of the participants on various aspects of the applied entomology training course

	<b>Excellent</b>	<b>Above Average</b>	<b>Average</b>	<b>Below Average</b>	<b>Poor</b>
<b>Please rate the training course:</b>	20 (67%)	8 (27%)	2 (6%)		
<b>How do you rate the contents of the course?</b>	27 (64%)	8 (19%)	7 (17%)		
<b>How do you rate the delivery of the lectures?</b>	30 (71%)	10 (24%)	2 (5%)		
<b>How do you rate the demonstrations and laboratory practicals?</b>	15 (36%)	13 (31%)	13 (31%)	1 (2%)	
<b>How do you rate the field activities?</b>	25 (60%)	11 (26%)	6 (14%)		
<b>How do you rate the food service?</b>	11 (26%)	3 (7%)	18 (43%)	8 (27%)	2 (5%)
<b>How do you rate the accomodations?</b>	2 (5%)	3 (7%)	12 (29%)	19 (45%)	6 (14%)

## Annex 5

### List of participants for the Applied Entomology Technician Course, 26<sup>th</sup> January – 12<sup>th</sup> February 2010, Liberia

Participant	County/District	Email	Phone Number
Buku Z. Baysah	Gbarpolu, Gbarma	<a href="mailto:vBaysah@yahoo.com">vBaysah@yahoo.com</a>	06-537657
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Francis Davies	NMCP/MOH		06-494804
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Anita P. Korgar	Maryland/Harper District		06-572892
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Edith Y. Zomonway	Grand Gedeh County/Muedru		06-819183